

Certainly until the appearance of this report, and by many even to-day, fusel oil is regarded as par excellence the injurious constituent of whiskey. This substance, which is a mixture of varying proportions, according to the spirit, of butylic, propylic and amylic alcohols, has apparently been maligned, and is not, at any rate in the proportion in which it occurs in ordinary potable spirits, a source of much danger to the public health. The chief other impurities touched upon at this inquiry were furfural and aldehydes other than furfural. At that time very little was known concerning the action of furfural or the aldehydes, and it is especially in this connection that the monograph before us is of interest.

Although there can be no doubt that it is the ethyl alcohol that causes alcoholic intoxication, it appears that the actual way in which one gets drunk, or gets sober after being drunk, depends largely upon the quality of the liquor partaken of. One of the most important factors in determining the quality is the content of the beverage in question in aldehydes, including furfural, another its content in certain volatile bases.

The source of furfural in the manufacture of whiskey is a class of substances known as pentosans; these are derived from the cellulose of the grain husks, and under the influence of heat, in the presence of acids, are in the wash still converted into furfural. Furfural is present in all pot-still whiskeys, and also obviously to a less extent in those patent still whiskeys which are blended with the real pot-still products to give them the taste of whiskey. Any one can apparently demonstrate for himself quite simply the presence of furfural in whiskey. It is simply necessary to dilute the whiskey and to add to it a few drops of an aniline acetate solution; almost immediately the whiskey becomes rose-coloured and later deep rose, changing to light purple according to the quantity of furfural present.

In addition to furfural there are also present in whiskey other aldehydes. Speaking generally, these bodies are poisonous, or at least irritating; they are for the most part converted in the body into the corresponding acid, and thus tend to diminish the alkalinity of the blood. This individual point is not without interest in that, according to most physicians, any cause tending to render the blood less alkaline favours the occurrence of gouty deposits in the joints.

The experimental inquiry concerns itself more especially with the action of furfural upon animals and man. This substance, according to Sir Lauder Brunton and Dr. Tunncliffe, gives rise to paralysis of the voluntary muscles, and later to clonic and tonic convulsions. An odd point about these symptoms is their transient nature; immediately after the injection of the drug the animal would fall down completely paralysed, its tongue and lips would become bluish and its breathing slow and convulsive, at other times irregular and rapid; convulsions would then appear, vomiting would occur, and then the animal would begin to recover, being at first dazed but becoming rapidly normal. Two human subjects who were bold enough to take this apparently active poison in the same dose got bad throbbing headache after it which lasted the rest of the day. This latter result brings us to what, from the practical standpoint, is the most interesting part of the research.

We believe it will be generally admitted that one of the commonest results of too free potations in the human subject is a bad throbbing headache, and it appears that the alcohol itself is only partly to blame for this disagreeable sequela. The aldehydes generally, and furfural particularly, play a very active part in the production of these headaches. This appears to be one reason why one is less liable to get a headache after old whiskey, for instance, than after new, or, speaking more correctly,

relatively new. One of the effects of maturation upon whiskey is to diminish the amount of furfural and aldehydes which it contains. This effect of maturation can apparently be effected by another means, viz., by distillation of the fresh spirit or of the low wines with phenylhydrazine-sulphonate. By this means the authors were able to obtain an aldehyde-free whiskey, and to watch the effect of it upon animals, comparing it with that of the same spirit before distillation. Their results are certainly interesting. They found that recovery from profound alcoholic, or rather whiskey, poisoning was distinctly different in the two cases. In the case of the original spirit, the animal, during the transition stage from drunkenness to sobriety, was restless, wandering from one part of the laboratory to another, and seemed, generally speaking, remarkably uncomfortable. Even when the gross symptoms of alcoholic poisoning had passed off the animal did not behave normally for some time; it refused food offered to it, and showed marked signs of bad temper. These secondary symptoms were entirely absent in the case of the aldehyde free spirit. When the animal was sober it appeared perfectly normal, and if offered food took it apparently with relish.

These symptoms, which cannot fail to remind one of the so-called "Katzenjammer" of the German student, are, oddly enough, most markedly relieved by precisely those substances which contain chemical groups capable of combining with and rendering innocuous these same aldehydes. The most general substance used in this connection is either ammonia itself or some compound containing amido (NH_2) groups. The action of all morning "pick-me-ups," from the student's red-herring to the viveur's effervescing citrate of caffeine, is apparently explainable upon this hypothesis, viz., that they neutralise the aldehyde constituents of the potable spirits.

THE ORIENTATION OF GREEK TEMPLES.

A PAPER, "Some Additional Notes on the Orientation of Greek Temples," an abstract of which was read before the Royal Society on February 14, gave an account of six Grecian temples of which the orientation had been examined or re-examined during the spring of 1900. The chief observations and results described in the paper may be stated as follows:—

(1) The grotto sacred to Apollo on Mt. Cynthus, in the isle of Delos, was interesting as being not improbably the very earliest existing structure of a religious character on Greek soil. The orientation seems, as usual, to have been connected with a zodiacal star, α Libræ, and the date of the formation of the grotto derived from this is about 1530 B.C. The original foundation of temples in Greece on some other sites are, indeed, more ancient than this; but it is presumed, and in a good many cases can be clearly established, that in those cases what can be now seen and measured is that which remains of reconstructions following the same lines as the earlier works. But this grotto at Delos, the sides of which are formed by the natural rock, and the roof and doorway only are artificial, is probably the very shrine alluded to by Virgil as already ancient at the time of the Trojan war (*Templa dei saxo venerabar structa vetusto*, *Æn.* iii. 84).

(2) At Delphi, where the clearance of the site by the French archaeologists gave a better opportunity of examining the celebrated temple of Apollo, there is evidence of a change of orientation, one, evidently the more ancient, having the angle $231^\circ 18'$, the other $227^\circ 8'$. These are the angles of the axis when looking east, measured from the south point round by west. The site is very peculiar, being surrounded by mountains. The sun must have illuminated the sanctuary through an opening on the flank, as was the case at Bassæ, also dedicated to Apollo;

and there are only two dips between the mountains where the sunrise could have properly represented the early dawn. One of these has for amplitude $-7^{\circ} 42'$ E., the other $-23^{\circ} 16'$ E. The latter, taken with the earlier orientation, and the bright star ϵ Canis Majoris setting near the western axis, where the local horizon is favourable, suggests 950 B.C. as the date of the foundation. The sunrise at the $7^{\circ} 42'$ point, and the sufficiently bright star β Lupi, setting also near the western axis of the more recent temple, offers the date of 580 B.C., but this would have been the predecessor of the structure which now occupies the site. It is known that the temple must have been several times rebuilt, and many stones of a previous temple, or temples, are found in the existing foundations.

At Syracuse it was found necessary to reconsider the orientation date (given in a former paper published in 1897) of the temple which has been attributed to Diana, but which is now known from an inscription to have been dedicated to Apollo. Of this temple, both the style of the architecture and the shape of the letters of the inscription above mentioned show that the date 450 B.C. given in the paper referred to, the orientation having been derived from the axis, is too late; and that the alternative date, derived from the northern limit of the eastern opening, which in this case can be obtained with accuracy, should be taken instead. The date, so altered, becomes 700 B.C., which is thirty-four years subsequent to the Hellenic foundation of the city.

N.B.—In Greek temples the question whether the sunrise entered upon the line of the axis or on the northern limit of the eastern opening has generally to be taken into consideration and decided upon archaeological grounds. This results, in the majority of cases, in favour of the axis; but in an important minority—notably at Athens—the other has to be chosen.

(3) In the paper an argument is drawn from the orientation of the foundations of a small temple lately discovered, adjoining the famous theatre at Taormina, that the theatre itself was that of the early and populous city of Naxos, which occupied the sea-coast at about 800 feet immediately below it; and not the work of the much later town of Taurominium, from which Taormina derives its name. Naxos was utterly destroyed by the Syracusans about 400 B.C.

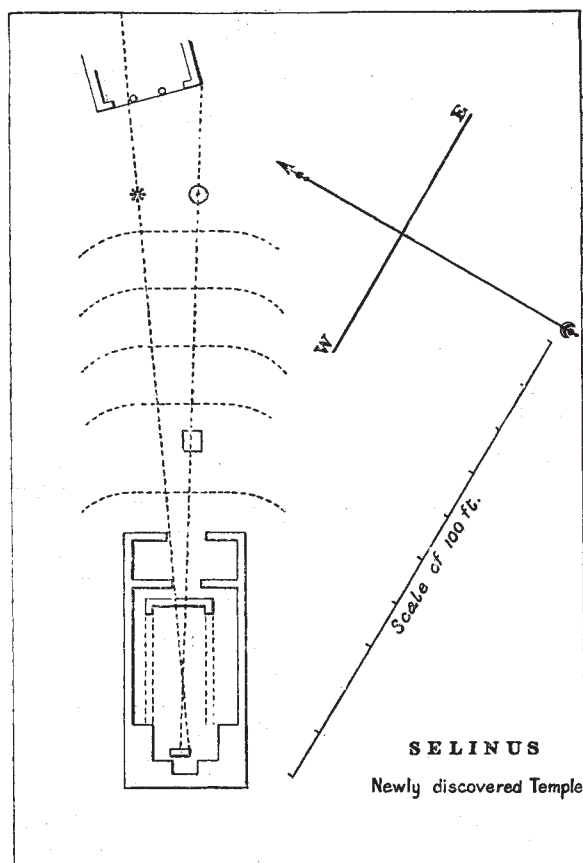
(4) The most interesting example, however, is from another Sicilian temple lately unearthed at Selinus. Of this temple I found the orientation of the eastern axis to be $30^{\circ} 22'$ north amplitude, which at once suggests a solar temple arranged for the summer solstice, which for a level site and for the date in question should be $30^{\circ} 35'$. But the temple's site is near the bottom of a valley; and the sun would have to gain an altitude of rather more than two and a half degrees before it could shine into the temple, and then the amplitude required would be $28^{\circ} 17'$. Thus, apart from what may be derived from the plan of the temple itself, the orientation theory would seem to show to a disadvantage.

The plan of the temple, however, appears to give the solution of the difficulty. It will be seen on examination of the accompanying figure that about 130 feet distant from the sanctuary there was a portico, *i.e.* the propylæa of entrance to the temple enclosure. One of two dotted straight lines drawn from this portico, namely, that which proceeds from its S.W. corner, indicates the direction of the first beam of sunrise as it rose at the summer solstice over the local horizon, about the middle of the sixth century B.C.; but it will be seen that whilst it passes centrally through the doorway it falls obliquely and eccentrically upon the western internal wall of the temple, the amplitude of this line being $+28^{\circ} 17'$ E.; but it will be also observed that it *does* fall centrally upon the western internal wall of a *naos* constructed within the

flank walls of the temple. The square object which the line intersects before it reaches the temple is an altar, itself of no great height, and on lower ground, and which therefore interposed no obstruction to the solar rays reaching the sanctuary. The difference of level between the floor of the temple and that of the propylæa is about 18 feet. The warning star β Geminorum, which would have been heliacal—that is, just visible before extinction—about an hour before sunrise, and the direction of which is represented by the other straight dotted line, would have been well seen over the roof of the propylæa, the height of which, as known from architectural fragments, would not have exceeded 23 feet, and the star would have overtopped this by about 2° .

The explanation, by help of the plan, of the apparent misfit of the orientation is as follows:—

Presumably the angle upon which the lines of the



temple were set out was taken from data obtained on some platform which had a level horizon, and the building was considerably advanced before the actual solstice came round and showed the error that had been made.

To meet the difficulty, a *naos* was constructed within the flank walls, but hugging the northern one; so that the first beam of sunrise coming through the centre of the eastern aperture, at the local amplitude of $+28^{\circ} 17'$ E., might shine in centrally upon the statue of the deity; and for this a pedestal was provided a little northwards of the centre of the niche which had been previously formed for it. We may notice also that the south-west angle of the propylæa is so placed as to keep exactly clear of the point of sunrise.

F. C. PENROSE.